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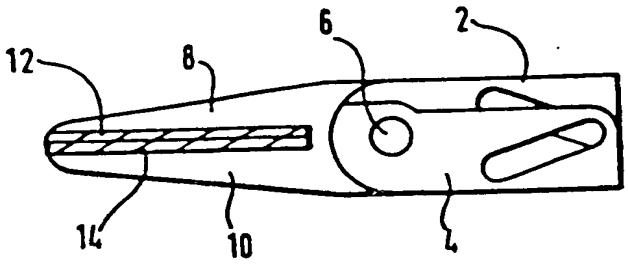
(54) Title: CLAMPING OR GRIPPING DEVICES

(57) Abstract

A surgical needle holder has the facing surfaces of its jaws lined with memory alloy which is soft enough to distort around a needle when gripped between the jaws. A better grip on the needle is thus achieved. The surfaces of the inserts may be profiled with ribs to allow the alloy to be subject to a greater pressure per square centimetre locally and so more readily deformed.



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CLAMPING OR GRIPPING DEVICES

The present invention relates to clamping or gripping devices, for example surgical needle holders.

Surgical needle holders include a pair of articulated jaws which are brought together to clamp or grip a surgical needle. Such needle holders are often required to hold needles having different sizes and shapes and because the area of contact between the surface of the needle (which is usually circular), and the surface of the jaws (which is usually planar) is relatively small, the needle is liable to shift relative to the jaws during a stitching operation.

It is an object of the invention to provide an improved clamping or gripping device.

According to the present invention there is provided a clamping or gripping device comprising a pair of cooperating jaws, at least one of the two facing surfaces of the jaws comprising a memory material which is deformed by an object when gripped between the two jaws, to increase the grip by the jaws on the object, the memory material being capable of resuming its original shape when released from the object by being subjected to a temperature in excess of a predetermined temperature.

According to the present invention there is further provided a method of producing a clamping or gripping device comprising the steps of providing a pair of articulated jaws, lining the surface of at least one of the two facing surfaces of the jaws with an insert of memory material and profiling the surface of the insert to have an undulating pattern when in its heat stable state.

Surgical needle holders embodying the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a fragmentary side elevation of the needle holder;

Figure 2 is a fragmentary perspective view of one of the jaws of the needle holder;

Figure 3 is a section through the jaws of a second embodiment of a needle holder;

Figure 4 is a section through the jaws of a third embodiment of a needle holder;

Figure 5 is a section through the jaws of a forth embodiment of a needle holder;

Figure 6 is a plan view of one of the jaws of a fifth embodiment of the needle holder; and

Figure 7 is a plan view of one of the jaws of a fifth embodiment of a needle holder.

The needle holder shown in Figure 1 comprises a pair of arms 2 and 4 pivotally secured together by a pin 6. Each arm 2 and 4 carries a respective jaw 8 and 10. The facing surfaces of the jaws 8 and 10 are provided with a respective metallic insert 12 and 14.

In operation, a needle carrying a suture is placed between the inserts 12 and 14 of the jaws and the jaws 8 and 10 are brought together by operating the arms 2 and 4 to clamp the needle between the inserts 12 and 14. The needle can have a variety of shapes, it can be curved, straight or otherwise profiled.

Each insert, which is advantageously 1 mm thick, is fitted in a recess of a respective jaw and is bonded thereto by brazing, soldering, gluing, mechanical clamping, riveting or sintering.

Each insert is of memory material, for example a metal or alloy.

Materials which possess shape memory are known. Articles made of such materials can be deformed from a first undeformed configuration to a second deformed configuration. Such articles revert to the undeformed configuration when subjected to specified conditions. They are said to have shape memory. One set of conditions

which will enable a deformed configuration of an article having shape memory to recover towards its undeformed configuration or shape is the application of heat. The material thus has a first heat-stable configuration and a second, heat-unstable configuration. A selected alloy is formed into its heat-unstable configuration at a temperature at which it is in a predominantly martensitic phase. Upon application of heat, the alloy reverts or attempts to recover from its heat-unstable configuration towards its first heat-stable configuration, ie, it "remembers" its original shape.

The ability in metallic alloys to possess shape memory is because the alloy can undergo a reversible transformation from a predominantly austenitic state to a predominantly martensitic state with a decrease in temperature. This transformation is sometimes referred to as a thermoelastic martensitic transformation. An article made from such an alloy is easily deformed from its original configuration to a new configuration when cooled below the temperature at which the alloy is transformed from a predominantly austenitic state to a predominantly martensitic state.

The preferred metal alloy for the inserts 12 and 14 is a titanium nickel alloy containing 50% nickel and 50% titanium. Other memory metal alloys which are biologically acceptable can also be used.

The alloy used is sufficiently soft that when the inserts are clamped onto a needle, the inserts will partially deform around the needle and so hold the needle more firmly between the jaws. After several clamping actions, the surface of the inserts becomes badly deformed and distorted and in certain parts will deform no further. When this happens, the needle holders are placed in a heat steriliser (at, for example, 110°C) to raise the temperature of the alloy from a level at which it lies in

its heat unstable configuration to a level at which it can resume its heat-stable configuration ie the inserts resume their previous undeformed shape. The needle holder is now both sterilised and reshaped ready to be used again.

In order to achieve a deformation of the surface of the insert with minimum force and effort and to achieve a satisfactory clamping action on the needle, the inserts may be specially profiled when in their undeformed state.

As shown in the embodiment of Figure 3, the facing inserts 12 and 14 have mating teeth and cavities so that when the jaws are closed the tooth on one insert engages a corresponding cavity on the other insert and vice versa.

In the embodiment shown in Figure 4, one insert has a concave surface profile while the other insert has a concave profile.

In the embodiment shown in Figure 5, one insert has a central longitudinally extending rib while the other insert has two spaced lateral longitudinally extending ribs straddling the control rib.

In the embodiment of Figure 6, each insert is provided with concentric circular ribs while in Figure 7 there are two sets of parallel ribs with one set intersecting the other set. The ribs may be in an array which emulates finger prints.

By using a series of ribs or teeth they are readily deformed by the needle which traverses them when the jaws are clamped together. The reduced area of the ribs enables them to be subjected to a greater pressure per square centimetre. The needle is thus imprisoned between the jaws and relative movement between the needle and the jaws is resisted.

The different profiles in the surface of the inserts can be achieved by casting or sintering the inserts in a profiled mold or by machining. If machining

is employed, the profiles can either be directly machined into the surface or produced by an indirect method. The indirect method involves using a die having a negative image of the ribs and deforming the insert in its heat unstable state with the die. The insert resulting negative profile is machined flat and the insert is thereafter heated to a temperature at which it can adopt its heat stable configuration. As a result, a positive version of the negative die profile materialises.

With needle holders, it is important that the memory alloy used has a transition temperature in excess of the temperature of the human body but less than the temperature used for sterilisation. A preferred range for the transition temperature is thus 60°C to 120°C.

Memory alloy inserts are particularly useful in needle-holders used for laproscopic surgery.

It will be appreciated that the memory alloy inserts can be used in clamping and gripping devices other than needle holders.

CLAIMS

1. A clamping or gripping device comprising a pair of cooperating jaws, at least one of the two facing surfaces of the jaws comprising a memory material which is deformed by an object when gripped between the two jaws, to increase the grip by the jaws on the object, the memory material being capable of resuming its original shape when released from the object by being subject to a temperature in excess of a predetermined temperature.

2. A device according to Claim 1, wherein each jaw has an insert of memory material to define the facing surfaces of the jaws.

3. A device according to Claim 2, wherein the insert is in the range of 0.5 to 2 mm thick.

4. A device according to Claim 2 or to Claim 3, wherein at least one insert has an undulating surface profile to localise pressure applied by the jaws on the object and so achieve local deformation of the inserts.

5. A device according to Claim 4, wherein the surface profiles of the two inserts comprise an array of mating teeth and cavities.

6. A device according to Claim 4, wherein the surface profile comprises an array of parallel ribs.

7. A device according to Claim 4, wherein the surface profile comprises two arrays of parallel ribs, the ribs of one array intersecting the ribs of the other array.

8. A device according to Claim 4, wherein the surface profile comprises an array of ribs arranged in concentric circles.

9. A device according to Clam 4, wherein the surface profile comprises an array of ribs in a fingerprint-like pattern.

10. A device according to any preceding claim, wherein said memory material comprises a titanium nickel

alloy.

11. A method of producing a clamping or gripping device comprising the steps of providing a pair of articulated jaws, lining the surface of at least one of the two facing surfaces of the jaws with an insert of memory material and profiling the surface of the insert to have an undulating pattern when in its heat stable state.

12. A method according to Claim 11, wherein the step of profiling is carried out by machining the surface in its heat-stable state.

13. A method according to Claim 11, wherein the step of profiling comprises stamping a negative of said undulating pattern into the insert when in its heat unstable state, machining the insert to provide a planar surface and heating the memory material to above its transition temperature to achieve its heat stable state and thereby cause a positive of said undulating pattern to materialise.

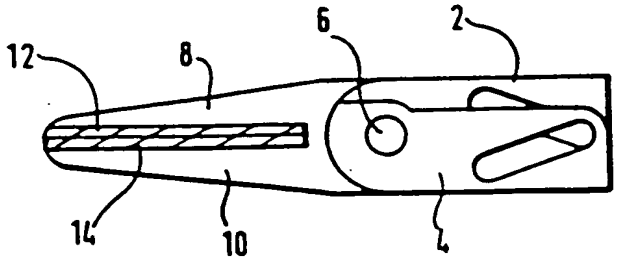

Fig.1.

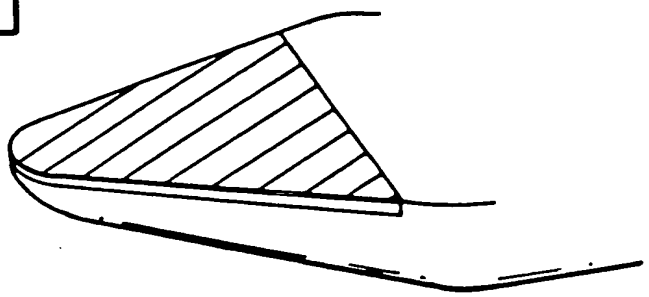

Fig.2.

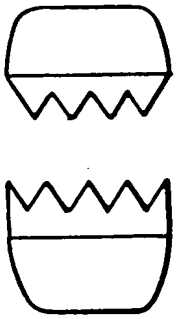

Fig.3.

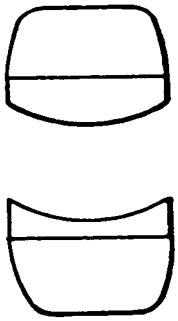

Fig.4

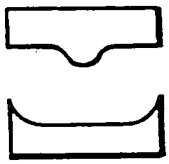

Fig.5.

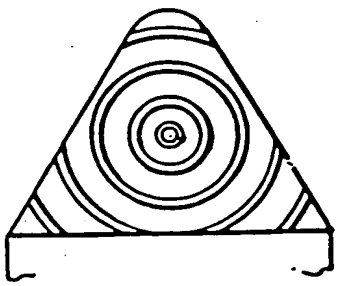

Fig.6.

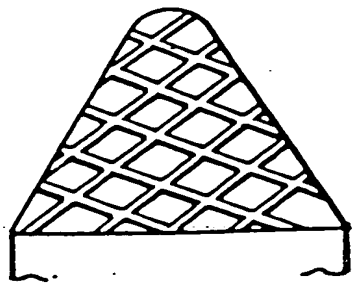

Fig.7.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB 94/02242

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A61B17/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,5 242 458 (BENDEL ET AL.) 7 September 1993 see column 3, line 55 - line 63; figure 3	1-13
A	GB,A,2 086 792 (MICROSURGICAL ADMINISTRATIVE SERVICES) 19 May 1982 see page 2, line 32 - line 47; figures 1,2	6,7
A	DE,C,416 689 (HARTMANN) 15 January 1924 see page 2, line 17 - line 31; figure 2	8,9

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A-5242458	07-09-93	NONE		
GB-A-2086792	19-05-82	CH-A-	655236	15-04-86
		DE-A-	3144224	24-06-82
		JP-A-	57110238	09-07-82
DE-C-416689		NONE		